SUPPLEMENT.

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GREAT NORTH TOLGUS, AND THE REDRUTH AND CAMBORNE MINING DISTRICTS.

THE GREAT NORTH TOLGUS MINE.

These districts have been famous for mining ever since any records have existed of the Cornish mines. Some of these mines have, it is said, been worked continuously for 100 years, but if we go back in our mind to 100 years ago we should find a very different state of things from what exists in the present day. A bridle-path then answered the purpose of a railway, and the mule did the work of the locomotive. Here and there along the lines of the great rich lodes that traverse the country a solitary turntree or hand-tackle might have been observed, where one of our hardy forefathers, in spite of all the inconvenience of want of funds and want of materials, with the small store of his tackle, rope, and kibble persevered in sinking shafts for tin, possibly against the warnings of friends and the pinching of poverty, for we find evidence of this in the tradition as to the old miners coming down to us in rude distich and rhyme—

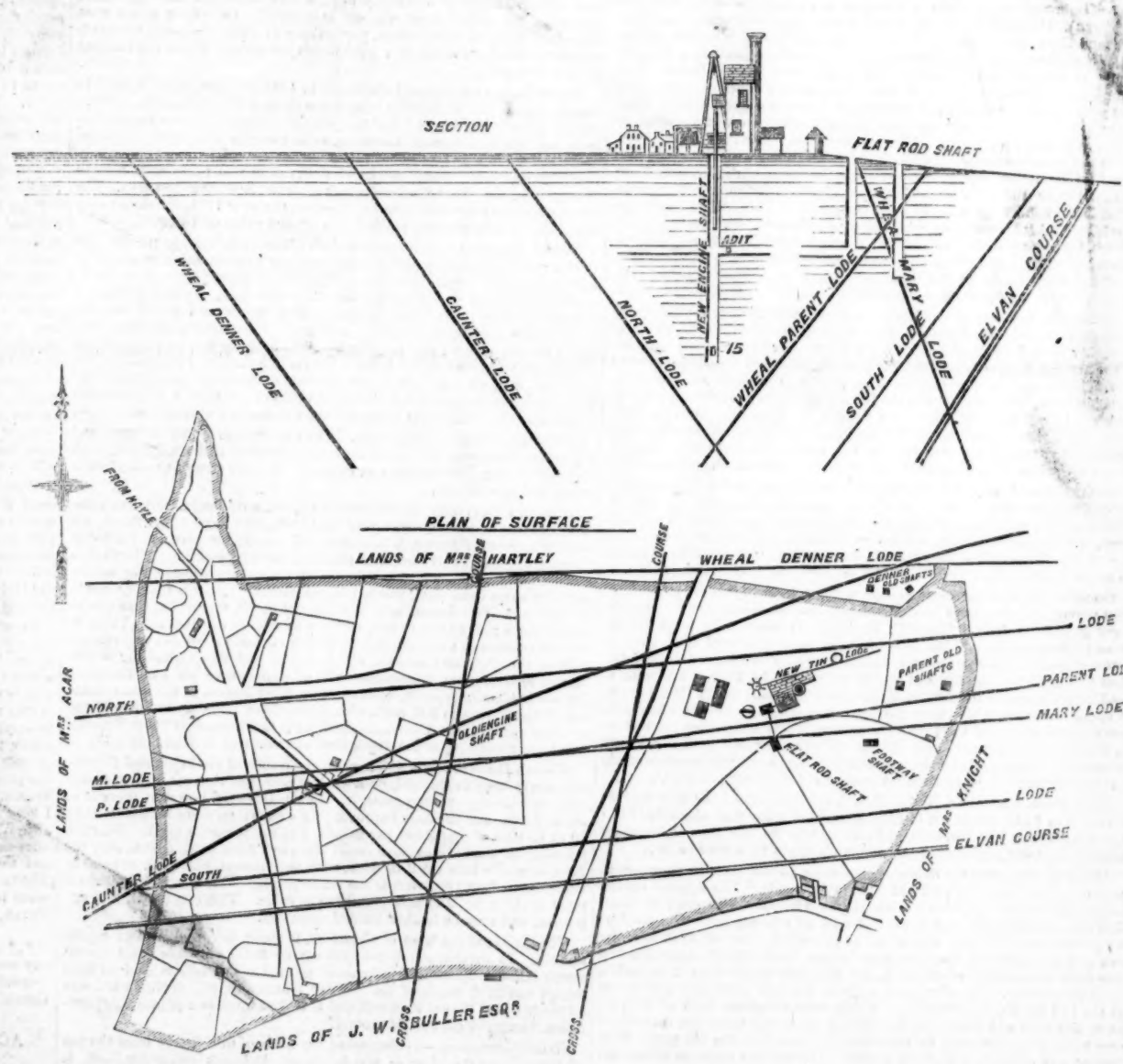
> "Uncle John Dorey up on the mountain
> Sinking of an adit shaft,
> For two or three month together
> This old rogue had neither shirt," &c.

Not that the people were averse to this sort of speculation, and the "old rogue," most likely, was a term of endearment rather than of reproach, and we find it so used in the Celtic of the present day. These hardy old miners laid open the out-croppings of the lodes, and made many of the great discoveries that are worked down to our own time in ranges of metal of miles in extent. But if any person had ventured to predict to Uncle John Dorey—that I translate to be John Bull, and the present John Bull of mining race still maintains the indomitable courage of his predecessor—if anybody had ventured to predict at that remote period that at some future time (say, in our own day) you might go from Camborne to Redruth upon the same range of veins, 200 fms. below the surface, he would have stared, and certainly have taken his informant to be an escaped lunatic. Nevertheless, this is true; the isolated trials of a past age have been all joined together by the ends of one mine extending to meet the ends of another, and those deposits of ore that were formerly termed bunches have been proved to run for miles in a line underground; and, notwithstanding the artificial boundaries at the surface, and the limited notions of man, there have been found no bounds below; and in looking over the country from Camborne to Redruth, the whole range may be considered as one great mine. We derive a lesson of useful knowledge from the state of things that have come about in this district—that is to say, that we should not be incredulous about the continuance of courses of ore ground for miles longitudinally, for here we have the fact before us; and although we may smile at the credulity of the man who fancies he is going to find a continuance of a good lode, and probably a body of ore, at a mile from some reported discovery, yet we see that such a state of things is well within the range of probability, since we have the testimony of undisputed fact to its truthfulness, affording evidence that masses of copper ore in the Redruth and Camborne district hold for three miles in extent: of course they are accompanied by divisions of unproductive lode, and interrupted by heaves and cross-courses in places, but the whole of the ground may be fairly considered as a continuous mine. Again, as to the depths of the ore formations, the old miners believed that you might find a course of tin on the top of a lode, and a course of copper below, and that was the order of things and the limit. It has been reserved for modern times to demonstrate that here again our preconceived notions had failed us, and that in our incredulity we had stinted the bountifulness of Nature. Capt. Charles Thomas, at Dolcoath, has had the honour of showing timid miners the way down in pursuing the treasures provided for man in the crust of the earth, exploding the old notion that there was only one layer of tin and one layer of copper ore, by sinking into a second layer of tin below the formation of the copper. What does this teach us, but that probably there may be a series of formations of copper and tin alternating with each other to depths undreamt of in our philosophy. What a figure of riches does this present to our mind! What an abundance of metal has Providence laid down for us! Imagine one line of metallic ground three miles long, and nearly, as at present shown, a half mile in depth, estimated at 20*l.* per fm. One lode for three miles in length, and 300 fms. in depth, would be worth between 24,000,000*l.* and 25,000,000*l.* sterling, and there are many such lines in this range of veins.

Where the mule was formerly the only beast of burthen that carried away the poor tinner's small dole of tin, you may now see the rapid steam-engine racing along the crests of the veins drawing hundreds of tons of metal behind it; while down deep below, confined between the walls of his lode, the tributer pursues his apparently solitary task with the gusto of an artist in love with his art; and as the ruby and black oxides, and blue and green carbonates present themselves, or the richer masses of the sulphurets, he gathers them into his hat-cap, and treasures them as if they were gold; and they are gold, or equivalent to gold, to him, and he wants no assayer or refiner to prove the value of his metal: he moistens it between his fingers, and applies it to the flame of his candle; and if it presents the right colour it is sufficient for him, if the flame be green he is certain he has rich copper, and what appears to the uninitiated a dull, monotonous life is in fact one of thrilling excitement, conveying to the mind all the variety and all the exhilirating influences of the chase.

We were arguing that Nature was unlimited in her provision of metals for man; that she continued her courses of ore through this rich district lengthwise for miles, showing that the greatest uniformity, instead of caprice, prevailed in her method, so far as the longitudinal arrangement is concerned, but she is equally profuse in her transverse lines of produce. Some fifty years ago, Capt. John Davey observing a glimpse of the great theory followed out and exemplified in modern times by Fox and others, that lodes contained their ores in parallelism, or opposite positions, following the run of these meridional belts opened in the Gwinear and western districts, which are in themselves merely an extension of the Redruth and Camborne districts, as many as sixteen profitable mines without, I believe, making a single failure. If we look at the meridional bearing of the Great North Tolgus belt of mines, we find contained from north to south Great North Tolgus, Old Tolgus, South Tolgus, Great South Tolgus, the Druid range of the Carn Brea Mine, South Carn Brea, East Basset, Wheal Basset, the western end of Wheal Buller, South Basset, and other mines of equal celebrity. How, then, with these great theoretical lines before us, which in practice have proved to yield so many millions of profit, can we undertake to say that Nature is capricious, and her laws unreadable? I do not undertake to say that we can understand the significance of all her laws, but still we know enough of them to use them for our successful guidance. It appears to me to be a wilful piece of ignorance to say that mining is all a lottery; that it is a dark, abstruse game, without scheme or plan, and only leading to ruin. A sort of "where it is, there it is," or a best-me-trust maxim, depending entirely upon haphazard. It seems to me a wicked presumption to ignore these guiding principles, that have led to so much fortune, and by following which, as I have shown, Captain Davey, fifty years ago, opened sixteen profitable mines, without a single mistake. In the matter of Great North Tolgus the analogies are perfect, and the predictions have been hitherto entirely verified, from the opening of the mine down to the present time, relying upon the great governing rules of mining. The whole mine has been furnished with excellent machinery; a 45-inch cylinder is now at work, all the buildings are erected, and everything is in good working order to take out the metal. On Wheal Mary lode a good discovery of copper ore has been made, and the mine contains an unusual number of good lodes, attended by elvan and cross-courses, which by their junction, as seen in the transverse section, it is certain will lead to unusually valuable courses of ore. The grant is nearly a mile in length, and of such width as to take in seven large copper lodes, Wheal Denner lode, the caunter lode, the north lode, Wheal Parent lode, which forms a junction with the north lode in the 30, or 13 fathoms under the bottom of the engine-shaft at present, Wheal Mary lode, now cut rich for copper, and the south lode, attended on the south side by a fine elvan course. It is impossible that such a combination of metallic phenomena could fail to lead to a successful mining issue, or to establish a great and valuable mining property—but mark the predictions.

On May 1, Mr. Spargo writes his clients—"I advise you to purchase shares in Great North Tolgus, as there is every appearance that the progress of the work will lead to good discoveries." The letter this week from the agent says—"I have now come up from underground, the lode (alluding to a course of ore recently discovered on Wheal Mary lode) still remains good. We have a fine lode going westward, and the course of ore is dipping fast to the westward. We haul some prime ore stuff to-day, specimens of which I send you per train. I enclose transfer of shares I have purchased from Capt. Dale. Are there any shares for sale in the London market, and at what figure? The water increases every foot we sink; the bob-stand is nearly ready." So that we are bound to con-



clude that this is the incipient stage of progress towards the establishment of a valuable mine, the plans of which, with a transverse section, is to-day placed before the public, in order that they may understand as well as may be the nature of this promising undertaking, and act upon their judgment as to the possession of an interest in it.

CORNISH NOTES—FOR "OUT-ADVENTURERS"—No. II.

BY J. Y. WATSON, F.G.S.

MAY 1.—I am writing this on the summit of Carn Camborne. Before me the blue sea, and the richest panoramic view in the world. By "richest," however, I do not mean in beautiful and verdant scenery, such as novelists would describe, for between the Bristol Channel and Carn Camborne I see nothing, as far as the eye can reach from east to west, but parched and barren ground, little mountains of rubbish, and tall, dark stacks of chimneys; I see, in fact, the richest mineral district in the world lying at my feet. I am looking upon mines from which scores of families have been enriched, and many beggared. From up those dark shafts men have come, as working miners, with "stones of ore" in their pockets, the forerunners of fortunes, which have made their descendants, in some cases, the largest landowners in the county, and others men of mark, of rank, and title. And now, as I look upon the apparently quiet scene, and watch the heavy beams of the engines work lazily up and down, thousands upon thousands of men are burrowing underground, like moles—some seeking an "*ignis fatuus*," others working by the light of a farthing candle, the "keenly lode," and as they work enriching others if not themselves. People may rail at mining as they will (and as they may have cause, perhaps, at *such* "mining" as they sometimes hear of in London), but what would England be without it? It is not only in itself a grand pursuit, but there is something enticing and fascinating in it. The "captain," when he makes a rich discovery, is like a successful general, and becomes at once a man of mark; and we, the adventurers, are like his victorious army, only we get better paid. Before I began moralising, I said that I was looking upon the richest mineral district in the world, and I am within the mark when I say that the group of mines before and around me have yielded mineral to the value of more than FORTY MILLIONS STERLING. Just at my feet are Stray Park and Camborne Vean, the latter worked without *once stopping* for 120 years, and yielding for copper in early times enormous returns, and more than 200,000*l.* in profit. Across the valley are the rich mines of West Seton, Wheal Seton, North Roskear, which made a profit of 100,000*l.*, and the Croftys 300,000*l.* in money in early times. Close in to my sight is Dolcoath (which has of itself, as Capt. Charles Thomas himself informed me, sold tin and copper to the value of FIVE MILLIONS STERLING). Cook's Kitchen, which has returned almost as much; then Tincroft and Carn Brea. At my back, and almost within a stone's throw, are Wheal Harriett and Condurrow; and then to the east of these the rich groups of Illogan and Redruth—South Frances, Basset, Buller, East Basset, &c. In the immediate district before me the mines generally were very rich for copper at shallow levels and down to a good depth; when the copper ore cut out, and tin came in, and between the two epochs, as it were, the mines were poor. Some of them now, Stray Park for instance, are in the transition state. In Illogan and Redruth the mines mostly produced tin at shallow depths, particularly in the backs of the lodes, and are rich for copper under it. Capt. Charles Thomas, the most experienced agent in the county, in a small work (to which I shall refer at a future time), entitled "Remarks on the Geology of Cornwall and Devon," calculates that the Camborne, Illogan, Redruth, and Gwennap Mines, all comprised within a run of six miles in length and two and a half in width, produced copper ores to the value of THIRTY MILLIONS STERLING, and are still producing 500,000*l.* a-year, and also about 120,000*l.* a-year in tin.

DOLCOATH has been at work, with a slight intermission, for 120 years. In the old working for copper it yielded about 600,000*l.* profit, and now returning 70 to 75 tons of black tin per month, and paying large profits. A remarkable feature in this mine is that the lodes are equally productive in the killas and in the granite, they keeping the same size and character in both. From the 10 to the 160 the mine was very rich for copper; from the 160 to the 190 copper and tin mixed; from the 190 to the 234, tin only. From the 220 to the 240 the lode branched off, the branch being the richest course of tin ever seen in the mine, and worth 200*l.* per fm. There are seven lodes altogether, and the mine 260 fms. deep below adit.

STRAY PARK is on the same lode as Dolcoath, and also in former times, in conjunction with CAMBORNE VEAN, made large returns of copper. The deepest level is the 190, and the shaft getting down towards another level, but not yet in granite, where the tin makes rich. There is no doubt the mine will do well at deeper levels, but time and money will be required to make it pay. A call of 1*l.* will be made at the next meeting.

COOK'S KITCHEN has been worked without interruption for more than 100 years; is on the same lode as Dolcoath, and almost as deep. In early days it yielded fully 2,000,000*l.* sterling. It made very large profits from copper, and of late has been making large returns of tin. Present returns about 20 tons per month, and on Thursday will pay a dividend, the first time for 51 years, the last having been paid in 1810. The mine is looking well, and in the bottom of the shaft 234 fms., worth 100*l.* per fm. A singular feature in this mine has been, that although the shaft has been sunk on the course of the lode from surface, it has never been productive in the shaft, and for more than 50 fms. did not show any trace of mineral whatever. Levels had to be driven a few fathoms to get into the ore ground; but the workings show that the tin ground is lengthening in depth.

EAST POOL was very rich at shallow levels for copper, and paid its first dividend in 1835 and its last in 1858, altogether it has paid about 40,000*l.*: the mine is now 140 fms. deep, and coming into tin, like the neighbouring mines. It is not expected to pay dividends again for a year or two.

WEST SETON, now the richest copper mine in the district, commenced profits in 1854, and has paid 115,000*l.* in dividends. The original capital subscribed by the shareholders was about 19,000*l.* The shaft is down 125 fms., and the 120 west is worth 4 tons of ore per fm. The ore dips away west, and 128 fms. west of the engine-shaft a new shaft, to take the run of the ore ground, has been sunk 10 fms. below the 28; near this is a fine lode, with stones of ore in it, and this part of the mine is in itself a good speculation. Another good point is, the new north lode will be cut at the 110 in about a fortnight. While these points are both of importance, and may add greatly to the value of the mine, there are reserves of ores to keep up dividends for some time to come from the old part. The present rate of profit is 24,000*l.* a year. The ore first came in about the 56 fm. level, first made profits at the 70, and the richest bunch of ore was at the 82. These facts are a guide to the prospective value of the speculation at the NEW SHAFT west, and also of NEW WHEAL SETON, the shaft of which has been sunk 176 fms. further west than the new shaft of West Seton, but is not so deep by 3 or 4 fms., now 5 or 6 fms. below the 28. In addition to the run of ore ground on the West Seton lode, the North Roskear caunter lodes run through the western part of the sett. This is a good speculation, and may make a good mine in time.

WHEAL HARRIETT is looking pretty well just now. About 20 fathoms of tin ground have been gone over at the 100, worth on an average, the agent told me, 50*l.* per fathom. The shaft is down to the 115, and driving commenced to get under the tin ground in the 100; this will take more than 12 months to accomplish. The profits now are about 100*l.* per month. The tinstuff is sold in the stone, there being no stamps on the mine, and consequently to a disadvantage.

The CARN BREA MINES are the most extensive in the district; the workings are on nine or ten lodes, and 1100 persons are now employed upon them. The profits have been over 200,000*l.*, and last year the returns were—copper, 14,511*l.*; tin, 48,522*l.*, and 14,000*l.* paid in dividends. At present, the fall in tin makes a difference of some hundreds per month in the returns, which are now about 4000*l.* for tin and copper. All the lodes throughout the mine produce both tin and copper, the Highburrow lode being the richest for copper. The deepest level is the 197 below adit, on Teague's lode; and here, as in Dolcoath, the lodes become more productive for tin in depth. The mines occupy a tract for a mile in length on the north side of the Carn Brea Hill, and are likely to be rich and productive for many years to come.

GREAT SOUTH TOLGUS paid its first dividend in 1855, and to this time has paid altogether 46,050*l.* The mine is adjoining South Tolgus, and near the Old Tolgus, which left large profits. The works are on two lodes, and the present returns are about 300 tons of copper ore in two months, and making a profit of about 700*l.* per month. The mine is down 125 fms. The bottom levels have not been looking so well for some months past, but there is a very good lode in the 100 west, and it is hoped the prospects of the mine will soon improve, so as to keep up the profits.

WEST STRAY PARK is now 90 fms. deep, with a lode in the shaft worth 30*l.* per fm. The mine holds out good prospects for a great mine, but requires a larger engine. The lodes are large and solid.

WEST FRANCES, adjoining South Frances and East Grenville, has thus far been a great disappointment, though in a fine situation. The works hitherto have been carried on east of the cross-course, and now they are about to costean for the East Grenville lode, west of the cross-course, and if met with there will, doubtless, be some excitement about it.

WHEAL UNY.—The tin part of this sett is looking well, but the chief feature is that in the north ground the shaft is down 37 fms., and cross-cuts driving to cut the East Carn Brea lodes. There is a good chance for a great mine here; at present, they are rather troubled with water.

WHEAL EMILY HENRIETTA, to the east of Wheal Seton, is a promising young mine, upon which a local company are erecting a 50-in. cylinder engine. The shaft is down about 20 fms., or 3 fms. below adit, and the lode from 2 to 3 feet wide, with fine indications for copper. It is under the management of Capt. John Daw, of Carn Brea.

SOUTH FRANCES, comparatively a young mine, commenced paying dividends in 1846, and has paid in profits to this time 175,688*l.*; original outlay, 18*l.* 18s. 9d. This has been from the eastern part of the mine, which is now poor. The western mine, where Pascoe's shaft has been sunk to the 104, and several levels commenced, is all in new ground, and has the appearance of opening out an entirely new mine, though a little time will be required to bring its returns into play. The ends here are yielding about 12 tons of ore per fm., and very promising. The 44 west is looking well, and the 74 is worth 25*l.* per fm. In consequence of the poverty of the eastern mine, the profits are small just now, and shares have declined, but from all I can gather, shareholders should hold on, and rather buy than sell. The first object I looked for when I got to the mine was John Vincent's cottage—that cottage now celebrated in history through the legal contest going on between West Basset and South Frances. Into the merits of that question it is not my intention to enter, but it is a great pity that it cannot be amicably settled. Two practical and disinterested parties would have settled it in a few hours, while it has now cost many thousands of pounds in law, and going up to the House of Lords. John Vincent's cottage stands on the boundary of the setts of West Basset and South Frances. From the north-east corner of the cottage to the south, or front corner, is a width of 30 feet, and one of the richest lodes in the district runs along under the cottage. The South Frances people say that the boundary of this sett is in a line with the north corner of the cottage. The West Basset party claim the line of their boundary at the south corner, so that both claim this piece of ground, 30 feet wide in the limits of each sett, and in which it is said there are at least 20,000*l.* worth of ore ready to take away—many I have conversed with upon the subject value the ore at 50,000*l.* Of course, it is a most important thing to both mines, particularly to South Frances, to which mine 50,000*l.* of ore would be a good bonus just now. This is the lode cut in East Grenville.

WEST BASSET commenced dividends in 1854, and has paid 126,000*l.* in the six years. At present the returns are about 3000*l.* per month. There are five lodes being worked, but the principal operations are on the engine-lode; and the best part of the mine, as is the case with South Frances, going west. In this part of the sett a new engine of 70-in. cylinder is in course of erection. There are good reserves in this mine, and, next to West Seton, it is about the best copper mine in the district just now. The present company purchased the mine about the year 1851, for rather over 800*l.*, and it soon afterwards reached a market value of 180,000*l.*

NORTH FRANCES.—The western shaft (Hunt's) is down to the 60. In the 50 the shaft got into the tin lode, which is a continuation westward of that in Uny and South Carn Brea. The shaft is carried down from the 50 to the 60, against the hanging-wall of the tin lode, without cutting it through, and at about 5 fms. below the 50 a branch or lode fell into the shaft from the south side, and has continued in the shaft to the 60, riding down on the wall of the tin lode. It has been opened on in the 60 for 10 fms. east and west of the shaft, where it is 2 ft. wide, composed of gossan, spar, &c., with good stones of rich ore occasionally, and is supposed to be Wright's lode, which in the eastern part of the mine is 10 fms. south of the tin lode. The lode in the 60 has a promising appearance.

POLGEAR, formerly Nancarrow, is to the south of South Frances, and under the management of Capt. Pascoe. The shaft is down 22 fms., with a pretty-looking lode for tin and copper. A little east of the shaft it is worth 20*l.* per fathom.

WHEAL GRENVILLE and EAST GRENVILLE, until lately, were one mine. The sett was divided about a year or so ago, and EAST GRENVILLE, the nearest to South Frances, is in extent 290 fms. on the course of the lodes. The engine-shaft is 68 fms. from the boundary of Grenville. The shaft is down about 32 fms., and the lode, which has caused considerable excitement for some time past, worth 15*l.* per fathom. This is the rich South Frances and West Basset lode, and, for the depth, everything that can be desired for a rich course of ore, which may not be far distant. There is but one opinion in the district as to its great promise; but as every change even of the slightest character will be noted, and telegraphed to the jobbers in shares, great fluctuations will, of course, take place in the price. Let the holders remember, however, that West Basset, in the same number of shares, rose to 30*l.* each, after having been given up by some of the practical agents of the district, and nothing in that mine, or at South Frances, was more promising at the depth than the lode now in East Grenville.

WHEAL GRENVILLE is 450 fms. on the course of the lodes, and the engine-shaft down to the 100, on a distinct lode from that cut at East Grenville, and having red iron about it. In the 100 west, however, there is no trace of iron, and the lode improving for copper; they are returning from 30 to 40 tons of copper ore per month, and the prospects good. Near the boundary of East Grenville a small shaft has been sunk 4 fms., and the East Grenville lode cut 2 ft. wide, with rich gossan, and quite as good as when cut in East Grenville at the same depth. This is a very important point in the mine, and adds greatly to its value. This sett is still very extensive, and may be further divided some day.

TOLCARNE, to the west of Grenville, is about paying cost from copper and tin. In driving south from the copper lode, a tin lode has been cut worth 60*l.* per fathom; 7 fathoms of ground of this lode is said to have turned out 370*l.* worth of tin. WEST TOLCARNE, still further west, was formerly called Wheal Maxwell, and is looked upon as a promising speculation, in a good channel of ground.

CARN CAMBORNE.—I commenced my notes of this district from the top of this hill, on the slope of which, towards Dolcoath and Stray Park, is CARN CAMBORNE MINE. In fact, while I sat on the edge of the saw-pit, trying to imagine that I could inhale the sea breezes through the mineral vapours or smoke from the mines, and writing my notes, Mr. Vivian and Capt. Paull were underground, breaking fine stones of copper ore from the lode in the adit; and Capt. Seccombe and Mr. Fawcett, the Chairman of East Caradon, were going over and examing the setts now composing the mine. In my Annual Review of 1860 I referred to this mine, and stated it would one day be introduced as a good speculation, and that from the reports I had seen I had purchased a large interest in it. Latterly one-sixth of the mine was offered to Mr. Fawcett, and has now been purchased by him and Capt. Seccombe, at a high premium; and as the purchase was dependent upon a personal inspection and thorough investigation on the spot into its merits and capabilities, I am justified in speaking of in the highest terms, notwithstanding that I have a personal interest in it. It is surrounded by the rich mines to which I have referred as making such large returns of copper at shallow levels, and when the adit was driven and the lodes cut the sett was too small to erect an engine upon; but now two fresh grants have been obtained of ground, both east and west, down to the boundary of Dolcoath on one side and West Stray Park and West Condurrow on the other. The lodes in the adit have yielded some rich ore, and a few tons are now at surface. Upon the south lode, which will soon form a junction with another, a small engine will be at once erected, the shaft sunk on the lode, and levels extended towards the cross-course, against which the riches of North Roskear and the Crofty's were found, and which runs directly through Carn Camborne. Capt. Vivian, of North Roskear, whose report, signed also by Capt. Daw, manager of Carn Brea, is annexed, is of opinion that we can sink to a good depth without an engine, and only a small one will be required for a depth of 100 fathoms, as Camborne Vean, Stray Park, and Dolcoath are draining the water below, and Wheal Harriett above. I have seen Capt. Daw upon his report, and he gives me the highest opinion of the lode. Towards the works in progress there is a working capital in hand of 1500*l.* There are now also 6000 shares, which are at 1*l.* each. Report of Capt. J. Vivian, manager of North Roskear, and of Capt. J. Daw, manager of Carn Brea Mines:—

"Carn Camborne is situate in the parish of Camborne, and in a first-rate locality for mineral; being just at the junction of the granite and killas. It is bounded on the north by a part of Dolcoath, the whole of Stray Park, Camborne Vean, and Wheal Frances; on the south by Wheal Harriett and Tryphena; on the west by a part of West Stray Park and West Condurrow; on the east by the southern part of Dolcoath and the northern part of Wheal Harriett; therefore, it will be seen that the limits are extensive. An adit has been brought into this sett at a very great expense by ancient miners from the southern part of Dolcoath; in which, within a distance of 40 fms., four very promising lodes have been intersected and opened on; the whole of them of good size, and impregnated with copper ore. On the most southern one a depth of about 10 fms. has been sunk, and the water drained by horse-power, and from which we have been informed several tons of good copper ore were sold. This lode, at the adit level, is split in places by horses of granite, but it appears to be concentrating as it goes down, and most probably will form one large lode in depth. We also find some old workings in the backs, from which we think some very rich parcels of copper ores have been taken away; and there still remains some very good ore in those places, which may be taken away at a profit. Our opinion is that this sett is a very desirable one, and that if properly worked it will ultimately make one of the great and profitable mines of the district.—JOSEPH VIVIAN, JOHN DAW."

On the road to Gwinear I passed several mines which it was impossible to visit; one of them, NEW FRANCES, I hear well spoken of. The chief operations are in the Wheal Top lode, which is down 7 fms. below adit, and worth 45*l.* per fm. for the length of shaft. At TREVOOLE the shaft is down to the 90, and elvan not yet cut, against which the ore makes. At the 80 the lode, supposed to be a new one, is worth 5 tons of copper ore per fm. There will be a good call at the meeting, but the returns are now about meeting cost. ROSEWARNE UNITED is looking poor, and will require a call of 2*l.* per share. A pitch in the 46 west, discovered by a tributer, is worth 30*l.* per fm. NEW HENDER, worked formerly as Wheal Hender, and before that as Copper Bottom, is about meeting half its cost, and looking promising. At ROSEWARNE CONSOLS the lode not looking so well in the end, but good in the backs; there are some nice piles of ore dressed. EAST ALFRED is improving, the 50 west, on the south or Alfred Consols lode, is worth 20*l.* per fm., and a cross-cut driving to cut the lode at the 70, and expect to see it in about three weeks: this should be watched. From what I can hear of GREAT ALFRED, the best thing the shareholders can do is to have all the ore picked out as fast as possible, and sell the machinery. WHEAL UNITY is very much improving, and some of the finest rocks of ore coming from the back of the 65 that can be seen in the county; one stone, broken a day or two before I got to the mine, weighed over 1 cwt., and supposed to be near 60 per cent. produce, I ordered to be sent to London for the Exhibition of 1862. This ore ground is whole to surface, and is opening out east, so that the 55 and other levels may soon reach it. The 75, also, is getting into ore. If the prospects continue as they are now, the shareholders will soon be relieved from "calls," and, I hope, be rewarded for their patience and many disappointments.

GREAT RETALLACK is down 1 fathom below the 35, and not looking so well for blende, but the lode contains fine flookan, mundic, spar, and crystals of lead. Some of the spar I saw had fine portions of lead in it. The agents think the lode will make lead in depth, and upon its doing so depends the lasting prosperity of the mine: 500 tons of blende are again being sampled, 150 tons of it the richest parcel yet sampled, and which ought in fairness to bring at least 3*l.* per ton. The engine is going only half the extent of its power, while a 50-inch cylinder, erected a short way off, is going 11 strokes per minute, and evidently taking some of the Retallack water. The mine is in an out-of-the-way place, and if some of the shareholders saw the road upon which the blende has to be carried in small carts, eight miles to the quay, they would wonder how 500 tons a-month are got there at all. I had 12 miles to drive to the mine over bleak moors and nasty hills. In about a fortnight the Peru silver lode will be cut at the 35 fathom level.

EAST BUDNICK AND MOUNT adjoins Retallack, and is in the slope of a hill, and in a good situation for mining and for mineral. As we drove up to Retallack, the agent of East Budnick came running up, and out of breath, to show us some fine leady stuff taken from a lode just cut, 9 fathoms deep, and of a very promising character, 2 ft. wide, close to an elvan course: this is supposed to be the engine lode, and a cross-cut at the 26 is going out to cut it at that depth, and it is a very promising thing. There are two other lodes, towards which cross-cuts are being extended, and a few months may see the mine in a good position. About 3 to 4 tons of lead are in course of dressing.

WHEAL HOPE is in the same valley, adjoining East Budnick and Budnick Consols. Formerly large quantities of lead were returned and smelted on the spot, and the lode not seen beyond a cross-course. An engine is being erected to prove two lodes, which, at shallow levels, have yielded good lead in the present workings. The mine is a good speculation, and will be proved at little cost.

ROSEWARNE AND HERLAND is poor, and has been a great disappointment, after paying two or three dividends. There are, however, four points now in operation, either of which may turn out well, and the cost about 150*l.* per month. The 30 end north is driving to cut Trevaskis lode. The 30 south to cut the Quarry lode. The adit west is driving to cut the Quarry lode in another part; and the 30 end east to cut the flookan, against which the Old Relistian Mine made so much ore. Bowling Green shaft, in which there is said to be a good lode of tin, is full of water.

In my drive to Retallack, I passed by several mines which in former times yielded great returns, and are likely, report says, to make some noise again. Of these NORTH DOWNS is looking well, and will probably yield a profit of 1000*l.* in the next four months. The bottom level, the 52 below adit, is worth 60*l.* per fathom; prospects altogether good. NEW TRELEIGH is also a very promising and rising young mine. Pryor's lode, in the 70, is worth 30*l.* per fathom, and ore coming into the shaft. These are both under the management of Mr. F. Pryor, who is now the manager of a greater number of mines than any other agent in Cornwall. He is also working one or two setts in the neighbourhood, the chief of which is WEST WHEAL VIRGIN, adjoining WHEAL DAMSEL, both good speculations, and I hope another time to enter more fully into this district. NORTH DOWNS AND WHEAL ROSE has for some cause or other been stopped immediately after the erection of a large steam-engine. The water is said to be high and the funds low, yet many speak well of the mine as a speculation. NORTH TRESKERBY, which is doing well, and a few other mines are in the same neighbourhood. To the right from Redruth is PEDN-AN-DREA, CUPID, LOUISA, NORTH GRAMBLER, GRAMBLER, &c.

*** As Mr. J. Y. WATSON is on a tour through the mining districts, any communications upon the mines referred to in his "Notes" may be addressed to him through Messrs. WATSON and CUELL, St. Michael's-alley, Cornhill, London.

ACCOUNT KEEPING AND MANAGEMENT IN MINES.

TO THE EDITOR OF THE MINING JOURNAL.

SIR,—Books of account, however well kept, will not put minerals into the earth, nevertheless the commercial instinct is that wherever expenditure of labour and materials is going on a clear and proper account of such cost should be kept, capable at any time of easy verification. From all persons in places of trust, managing servants directing labour, the custom of the world is to demand an account set forth in items detailed. To judge correctly as to the value of such universal custom, suppose the contrary to prevail, what could be the result but confusion, destruction, anarchy, chaos? Trade cannot exist unless accompanied by its guide and protector—Account; and the law ordains that all statements of account must be capable of proof whenever demanded. Even the race-course hath its books; the card and billiard tables their accounts; and all wagers are recorded as proof to substantiate facts.

Cornish mining is an exception to this universal rule in the trade of the world. In the underground charges they are not always accompanied by an easy satisfactory proof. For the accuracy of many very heavy charges, constantly going on, a faith, a trust in the honour and veracity of agents is demanded repugnant to the man of business habits, and which no merchant admits in any of his transactions. Take a mining manager's sheet of underground charges as an account to be examined. Let the investigator be one whose intellect has been schooled to accept no statement as true unless supported by tangible proof; or a banker, who when dealing with money-charge account allows of no shadowy suppositions, but will have a material security that all figures representing charge are correct. Such men are wise in their generation, and firm in the opinion that a man who pays money without knowing whether he receives a fair equivalent in return must be considered a silly one, to whom Nature has denied reason. Supposing the underground charges laid before such examiners, and they will not admit any plea as to "custom of adventurers" to take the place of necessary evidence; that they repudiate all blind silent faith in unchecked accounts, but, on the contrary, demand minute material evidence as to the strict accuracy on every point relating to such charges, amounting probably to an outlay of thousands of pounds; what evidence will be given to them that they can in any rational way deal with to verify the same? This is a point well deserving serious consideration by all, both out and home adventurers.

In dealing honestly with the mineral veins of Cornwall, it is only just to demand on their behalf, and for the integrity of mining, that all charges made for underground labour be stated separate and apart from all other charges whatsoever, and that each of the items be supported by reasonable evidence, capable of demonstrative proof, showing that the work done is in accordance with the Cost-book Principle—contract and measurement. Exceptional cases can always be explained; and such explanation will invariably prove the extreme necessity for a rigid adherence to its principle.

When an underground agent is engaged by a mining company, his qualifications as to

an experienced practical knowledge of the labour charge for opening of ground, preparing minerals for sale, dialling his workings, plotting the same by scale on a working plan, are all not only very fully gone into, but his statements are required to be supported by written testimonials from known parties of respectability. The reasons for such cautious, careful enquiries are—That the labouring miner for a fair day's work shall receive a fair day's wage; that such wages shall fluctuate only with his own exertions, thus giving to energy in work that which sloth can never command—the full reward of steady labour. That the minerals when raised be properly and economically dressed for sale, avoiding waste and loss from ignorance. That all opening of ground shall be dialled and laid down on a scale in the working plan, so that every part of such underground labour shall be as susceptible of proof by admeasurement as any work done in the light of day at surface, in building houses or making machinery, and with figures of reference to the folios in the setting-book, where the contract for the work is set forth. Very sound reasons these are, founded on business principles, and well adapted to verify underground expenditure, test its accuracy, and show the character of the management.

The machinery of a clock may be wound-up to work a day, week, or month without further attendance; but men cannot be so wound-up. Wherever human labour in mass is at work, there the personal superintendence of the labour-director is indispensably necessary. His eye and voice are required to be in constant watching, waiting, encouraging, directing, if labour and capital are to receive their fair due. If true principles of management in working be not carried out the fault lies with the employer, not the employed. It is the bounden duty of the party supplying the capital to see that proper accounts, and vouchers in proof, are produced. For their own *laches* they are not justified in blaming others; and they have no right to forget that if you want any particular work done you must yourself see that it is done, or in default take the necessary steps ensuring its execution.

The duties of a mine *manager*, when faithfully discharged, are of a very laborious and responsible character. He expends capital in the manner of a trustee, carefully anxious to avoid loss. He has so to manage *labour* that the honest miner shall not be reduced to a level with the man of careless sloth; that the energy and industry of the steady shall not be measured by the same scale as thoughtless idleness makes. All men do not work alike; skill, intelligence, and perseverance will always take the lead, and should be allowed free scope, by having fair play for its energies in striving for high reward. The thoughtful manager reflects profoundly and carefully on these matters in the science of labour when calculating prices of ground to men.

In the consumption of *materials* he guards against waste, knowing that economy is a practical virtue, adding largely to the power of capital. Liberally looking at wants, he carefully weighs the practical quantity required, looking at the demand and necessity in each case submitted for his decision.

In *working the lodes* he is guided by the eye of sound reason, matured probably threescore years in the school of practice. Chance will dog his steps, but he leaves as little as possible to its vagaries; hence in the empire of calm thought he plans his operations, basing them on facts, guided by patient calculation, in a manner to command the approbation of experience, meriting success. Shunning the mere sciolist, the superficial nonentity, he seeks the support true science yields from practical knowledge, methodically arranged on truths and principles.

In *preparing minerals* for market, his practical habit compels him anxiously to calculate the cost of every process passed through, omitting no item, however small. With this accurate information always before him, he is enabled to guard against capital being squandered in raising worthless ores, which, while they swell the amount of sales, giving a fictitious value to returns, carry with them a heavy loss. Comparing his dressing cost with other mines indicates probable improvements for his consideration in some of the arrangements.

Examining often his *stock account* of tin, he becomes well aware of any differences between assay and sale, taking care that all mineral is brought to account, whether broken by tribute, tutwork, or on owners' account. He is very watchful to avoid those serious losses which in some mines arise from careless dressing,—quantities of mineral carried away by the washing waters.

When arranging the *accounts* of his quarterly management, to lay before the shareholders, he is desirous that the explicit clearness of the charges, in their description, order, and arrangement, shall be such as to carry full and satisfactory explanation to the general meeting of adventurers, commanding confidence and winning thanks.

His *owners' account* comprises the staff and all persons on monthly wages. He has *sundries* to a heading of various charges, all the items of which he sets forth on the cost-sheet or subsidiary books, he uses no "&c." The *tutwork* and *tribute* charges he makes remarkably clear, by mapping all opening of ground on the scale used by his masons and engineers in building houses and making machinery, raising no imaginary or idle difficulty about its largeness, his wish being to show the ground not only that he has opened, but adding a reference figure to the folio in the cost-book, where cost and yield from each contract are brought together. Thus, the cost-book kept according to his own methodical system, in connection with his most excellent working plan, every result of profit and loss are at once seen on each, all, and every of his underground workings.

This working plan of his, so eminently useful and beneficial to adventurers, is also of inestimable value to the mining student when practically studying changes in mineral veins, by allowing of every effect to be seen arising in the rock, from any cause whatsoever, acting on the vein in its course, dip, size, hardness, or quality. The varying phases accompanying unions and intersections of lodes with flookans, slides, cross-courses, and elvans are at once visible.

There is no subject matter of business on which the general public are more profoundly ignorant than that of the mode of account and system pursued in working of tin and copper mines; hence a faithful mine manager, knowing there must be mining for the million, zealously endeavours, by studying perfect arrangement, method, and order in all his proceedings, to show to the million that of all speculative pursuits for accumulating wealth mining is the most honourable, elevating, and ennobling.

STATEMENT SHOWING WORKING CHARGES IN THE FOLLOWING MINES ON EACH 20s. VALUE OF PRODUCE SOLD.

Months charged.	Sales of produce.	Working charges. Average in 20s.	Working charges. Amount.	Profit.	Loss.	Mines.
1861. Jan., Feb.	£10,731 12 9	£0 14 9¾	£ 7,932 15 11	£2798 13 10	....	Dolcoath.
1860. Nov., Dec., Jan.	4,625 3 6	0 18 7¾	4,302 0 7	323 2 11	....	Wendron Consols.
Oct., Nov., Dec.	4,087 16 6	0 18 7¾	3,807 14 9	280 1 9	....	Great Wheal Vor.
April—Aug.—Dec.	20,549 5 3	0 18 11¾	19,452 6 1	1096 19 2	....	Tincroft.
Dec., Jan.	3,066 5 9	1 2 3¾	3,420 8 1	....	£ 354 2 4	North Roskear.
Nov., Dec., Jan.	6,688 17 4	1 3 1¾	7,741 12 10	....	1,052 15 6	Great Wheal Busy (Proper).
May—Jan.	3,379 9 8	1 8 0⅝	4,737 6 5	....	1,357 16 9	Rosewall Hill and Ransom.
Nov., Dec., Jan.	1,501 8 9	1 8 9	2,159 19 5	....	658 10 8	Basset and Grylls.
1859. June—Dec., 1860.	15,293 13 2	1 8 9¼	22,008 7 0	....	6,714 13 10	Wheal Lewis.
Total	£69,923 12 8	£1 1 7¼	£75,552 14 1	£4198 17 8	£10,137 19 1	

The above is a table, omitting all balances and extraneous sums, showing the average working charges on each 20s. value of produce sold from the mines named. It is the wish of parties largely interested in working of mines in Cornwall to have this average charge allotted under various heads, so as more clearly to see separate cost. The following are some of the heads required, varying with circumstances:—Owners' account, drainage, winding, opening new ground, opening old ground, tribute, dressing. The mine books in current use will readily allow of the manager embodying this information in his report to the adventurers. Then, with the value he places on the lodes, he will also show his charges for working the same. These mines are not selected, but the accounts being at hand were made use of.

MENTOR.

SEAL LOCKS FOR SAFETY-LAMPS.—The merits of this description of lock (proposed by Mr. P. H. Holland some time since in a paper read before the Society of Arts) were carefully discussed at a recent meeting of the Manchester Geological Society, and the conclusion which we think must be drawn from the discussion is, that the proposition is far more likely to prove useful in theory than in practice. Mr. Dickinson, Government Inspector of Coal Mines, said that the great point was to have a lock, no matter how simple. In the Manchester district there are many simple locks, and if proper attention on the part of the manager is shown not to allow the lamps to be opened with impunity, these simple locks answer all the purposes intended. The thin strip of metal constituting the lock is to be broken every time the lamp is opened, and a fresh strip, or lock, has to be used when the lamp is re-locked. Mr. Livesey considered the lock would be effectual in preventing the lamps being opened without detection. Mr. Higson, Government Inspector of Mines, was inclined to report favourably upon the lamp, but quite agreed with Mr. Dickinson that a simple lock would answer every purpose for which a lock is intended; one thing to be feared in regard to this strip of metal was, that if adopted nominally as a lock the lamps would be too frequently given out without it. Mr. Farrimond thought that a lock, though simple, ought to be such as would prevent colliers opening it. The Chairman (Mr. E. W. Binney) remarked that it was dangerous to send forth a lock with the declaration that "proper safety-lamps cannot be exploded." Mr. Dickinson in his experience had not had a case where fire-damp had fired through a safety-lamp in good order. Mr. Livesey knew one case where a safety-lamp did fire, and several men were killed. The man finding the lamp got hot laid it down, and others thinking that if left it might be burnt through, one man went to fetch it, but it was so hot he let it fall, and the oil running out it exploded. The Chairman thought that in these unfortunate cases there is generally no man left to tell the tale, or we should hear of many cases of explosions caused by proper Davy lamps improperly used. Mr. Wm. Blackburne thought that if a lock must be used it ought to be a proper one. Owens's is the best he had seen. Mr. Dickinson remarked that Owens's was a double lock. Mr. Blackburne said it was, and that if they used any they should use a double one. Mr. Dickinson remarked that Stephenson's lamp is made on the principle that they should go out if there was much fire-damp, and in Belgium no lamp is allowed which is not constructed on that principle.

ON THE RISCA EXPLOSION—No. II.

[READ BEFORE THE ROYAL SCOTTISH SOCIETY OF ARTS, EDINBURGH, MARCH, 1861.]

BY RALPH MOORE, MINING ENGINEER, GLASGOW.

The opinion of parties who examined the workings was that the explosion had originated where this lamp was found. The men were taking down some top coal there, and a heavy fall of shale had followed, from which a blower of gas issued for some days afterwards. The first explosion must have been a very slight one, but sufficient to knock down the timbers supporting the roof, and other falls ensued, liberating more gas, and causing more explosions. It appears to have passed from No. 4 to No. 3 cross-heading, No. 3 east level; another portion seemed to have split off towards the slope, and from thence into No. 3 west level. The fire in the east side appeared to have been in No. 2 east level, for Mr. Harrison's son was found burnt there; but all seemed to agree that the greatest loss of life was caused by the explosion deranging the doors, whereby the air currents did not descend to the bottom of the slope, and these workings were laid quiescent, and filled with after-damp, which suffocated them that were not injured by the fire. The falls would also prevent many from escaping that might otherwise have got out in safety.

It was shown that the men were in the habit of taking the gauze from their Davy lamps, and that men had been fined for so doing, but still it was persisted in, the men believing the air was so good that the lamp was a needless precaution; and it would appear that formerly the pit was worked with naked lights. It was conjectured, therefore, that a quantity of gas was forced out by the fall in question upon some exposed light, or, perhaps, upon the insufficient Davy lamp, and the explosion was the result. The whole evidence appears to bear out this, and especially the fact of the slightness of the original explosion, seeing that the lights of many of the survivors were never put out, which would not have been the case had it been extensive.

The discipline of the pit was questioned, as before stated, but there seems to have been little room for doubt on this point; the officers appeared, especially Harrison, to spare no time or exertion to maintain it efficient. The ventilating-machine was much criticised, but beyond a kind of vague dislike to machinery for ventilating purposes there does not appear to have been any tangible objection to it; on the contrary, its performance had given every satisfaction—it had gone almost uninterruptedly since its first application, two years before, and its action at the explosion had shown it to be capable of withstanding the shock of such an event, while there seems to be no doubt as to the freedom from fire and accessibility which is sometimes wanting in the ventilating-furnace; add to this the absence of smoke, and saving of the sides of the shaft and pitwork. It appears to have been put up most substantially, works smoothly and steadily without the slightest jolt, and looks like a machine that will come into more general use.

Much was said about the length of the air currents going into the east side, but it appeared that the first explosion occurred where the air had only travelled 1000 yards from the shaft. Also of the necessity for splitting the air into more divisions, which undoubtedly would have lessened the pressure on the doors and stoppings, and thus have caused less leakage; but the speed of the ventilator was the measure of the air, and unless additional speed or more ventilators had been applied the quantity of air would not have been increased.

After sitting 19 days hearing evidence, the jury recommended that the present rules be revised, that the ventilation should be so arranged that in case of any future explosion its results should be confined to the district in which it took place, that a new pit be sunk, and that Stephenson's lamp is the safest. They could scarcely have said less, but it is clear they do not point out a remedy, nor do they approach the main cause of the disaster, for it appears to me, so far as ventilation is concerned, that under the present mode the same thing might occur without the ventilation was very largely increased. The great error appears to have been that only the seam of coal was attempted to be ventilated, and no attempt was made to ventilate the strata above it, which was known to be so highly charged with gas, or to draw the gas from the roof, which was opened up by falls occasionally as high as the Big vein, and which found its way into the Black vein workings, sometimes in sudden gusts, when driven out by falls from the vacuities in which it was lodged.

The only remedy we know, and the only one I have to propose, for the removal of these sudden gusts of fire-damp is Ventilation, by opening up the strata in such manner that the gas may be drained off from the upper strata at the same time as the coal is worked away; and to do this economically every facility is offered by making drifts in the Big vein, and by staples or connections every 100 yards to open up the strata, so that it would be ventilated, and the gas be drained off into the seam above. The air current could be taken down the Black vein, and split into as many divisions as found necessary, and any reasonable quantity of air might be sent through the mine, and re-ascend by the Big vein to the upcast.

But it will be seen that in the present system there is another fatal arrangement, and one that on ordinary occasions it is difficult to overcome—that when the air courses are all carried in one seam an explosion of fire-damp destroys the ventilating arrangements, by blowing down doors and knocking out stoppings, so that the air currents, instead of flowing in their wonted course, find the nearest way to the upcast shaft, and those who are not burnt are left without any means of dispelling the fatal after-damp, or receiving a supply of fresh air; and thus it happened that in this very explosion seventy people died from the effects of after-damp. Supposing such an arrangement as above proposed, the air would at once find its way to the last communication between the two seams, and to that extent ventilation would be resumed immediately, much in the same way as when there are two pits, one for an upcast and the other for a downcast, instead of one pit with a brattice in it. In the former case the ventilation, so far as the pits are concerned, adjusts itself immediately, in the latter the derangement of the brattice or midwall stops the air until it is replaced.

With regard to safety-lamps, they may be continued in any fashion, but so long as they require a supply of atmospheric air no mode of locking will be found perfect; and so long as our mines depend for safety upon the exclusion of naked lights, so long may we expect to hear of explosions. It is frequently the fashion to blame the recklessness of the workmen, who by their neglect of the rules laid down for them bring on themselves and others such catastrophes; but we may often include the owner of the mine, who, by his neglect to get the proper advice or plans for conducting his mine, subjects himself to great loss, and the lives of others to great risk. He should, both for his own sake and for the sake of the workmen, spare no expense in procuring the very best assistance on this point.

It will be remarked that I have only noticed one mode of dealing with fire-damp—by its dispersion or dilution with atmospheric air, by making the atmosphere of the mine approximate to the surface; but I am of opinion that to chemistry we will have yet to look for additional assistance, for it is a very singular fact that the most deadly gas we are acquainted with—carbonic acid gas—contains two-thirds of the most life-giving gas we have—oxygen. I have a fancy that some of our chemists, a second Davy, will put us in possession of a simple available means for taking up, in this case, obnoxious carbon, so that out of the most deadly gas we may have a life-giving residue.

It has also been suggested that the ELECTRIC LIGHT would be very suitable for mines. I wrote to Prof. Faraday on this subject, stating that I did not see any difficulty in taking in a main wire, sufficiently insulated by coating, with branches into the various working places. The difficulty would be in the electric machine, and in the apparatus in which the light burnt. I was told that an electric light was in operation in a lighthouse at North Foreland, and the apparatus was driven by a steam-engine of four-horse power. As far as steam power is concerned, that can easily be got at a colliery, if the machine be simple and inexpensive. The apparatus containing the light would require to be not more than 4 to 6 in. square (and the light to be inaccessible to the party using it), capable of being moved from place to place, say, in a range of 30 feet; of being turned upside down, but this is not indispensable; not easily put out of order by a jolt or slight fall, or injured by damp. Prof. Faraday said, "I do not think the magneto-electric light will be applicable to mines in the way you propose. I think the lamp would be too delicate to bear the knocking about which it would receive from the miners, and that you could not reduce the sum total of light into a number of small parts, so that each man will have one to deal with." Prof. Faraday sent my letter to Mr. Holmes, the patentee of the light erected at the lighthouse, and he wrote me: "Prof. Faraday has sent me a letter from you to him on the subject of the magneto-electric light applied to mines, and wishes me to answer it. I, therefore, beg to state that the magneto-electric light is not capable of division into small lights; it is one light, of immense power, equal to hundreds of thousands of wax candles, and yet cannot, I should think, be made available for lighting mines. Some years ago I invented a miner's light, produced by a small portable battery (galvanic), perfectly safe, and giving a light quite equal to a good candle. The light is hermetically sealed in, and has no communication with the external air. The small glass globe in which the light is produced may be a vacuum or not. The cost of such a light (working expenses) would be, I should suppose, about 1d. per day, perhaps less. The prime cost something between 3*l.* and 4*l.* I cannot exactly say, as I have only had a few made for experiment." Mr. Holmes' address is Northfleet Ironworks, Northfleet, Kent.

But with all the precautions which can be used it would be too bright a prospect to hold forth, that we shall ever reach a time when there will be no more explosions. The spread of scientific knowledge, and its application to practice, will prevent those disastrous exhibitions such as Risca, but man is fallible, and we shall never entirely arrest them, and I will conclude my paper by suggesting that some provision should be made for those injured, or for the relatives dependent upon those killed. Insurance seems to be the simplest remedy, but there is not sufficient data to estimate correctly the premium necessary. The nearest estimate I can arrive at, and it is only a guess, is that on an average the deaths from explosions are 200 annually, and that 500*l.* would be required to purchase an anuity to make the dependants as comfortable as they were, and that at least one-half as much more would be required to pay a weekly ailment to those who were injured, which would be in all a sum of 150,000*l.* yearly. That is to say, if each of the 200,000 colliers employed paid a premium of 15s. a year, he could insure himself a weekly ailment while disabled by injury from fire of at least the weekly wages he was in the habit of receiving; and in the event of his decease from that cause, his relatives would receive 500*l.* I suspect this is not far off the truth, for I find the Accidental Death Insurance Company for a yearly payment of 10s. insure 500*l.* on death, or a weekly allowance amounting to 250*l.*, from railway accidents, and I apprehend that the risks will be about the same.

The coalmaster might protect himself from compensation claims by this means; for instance, he could pay a premium on a certain number of men, and at the end of six months the actual number of workmen employed at his works for the past six months could be ascertained, and the excess or deficiency made up, as the case might be. I am not sure but the masters themselves should be liable to damages for such catastrophes; they are certainly not beyond the reach of efficient mining; at all events, we know from experience that the most powerful appeal is that which is made to the purse. It must be remembered, however, that accidents from explosions are not so numerous as those from other causes; and it would be well for the mine owner to enquire whether a system of insurance should not be made to cover all accidents, the premium to be paid partly by the men themselves and partly by the masters. I have an idea the result would be a diminution of accidents, and that we should have a superior class of workmen to that which now exists.

[The paper was illustrated by very carefully-executed diagrams, showing the mode in which the operations at Risca were carried on, and the system of ventilating in use; an accurate representation of Struvé's Ventilator was also exhibited.]

RISCA COLLIERY EXPLOSION.—A very worthy companion to Mr. Maynard's report of the inquest relating to the Hetton Explosion has just been issued by Mr. Henry Evans, of Newport, in the shape of a detailed report of the evidence given upon the Risca Explosion. The accuracy of the report is to a great extent guaranteed, owing to Messrs. Brough and Evans, the Government Inspectors of Mines, and the other scientific gentlemen examined as witnesses, having rendered every assistance in overlooking and correcting the evidence. The explosion at the Black Vein pit occurred on Dec. 1, 1860, and of upwards of 200 persons who descended the pit in the morning only about 60 escaped—142 being the number killed. Most of the bodies were recovered within a fortnight, but so extensive were the falls that the last body was not brought to surface until Feb. 5, 1861. After several adjournments, the inquest was opened for taking evidence on Jan. 12 before Mr. W. H. Brewer, and after nineteen days' careful and deliberate enquiry the verdict of the jury was given, the details of which have been long familiar to our readers. In the work before us* the whole of the evidence is carefully collected and arranged in the order in which it was given, inserting the various documents referred to by the several witnesses. Not the least important of these is the notice given to Messrs. Russell and Hookey by the late lamented Mr. Herbert Mackworth in 1855, which may be regarded as furnishing a key to the whole subject, since it explains the position of the workings at the time when the report was made, the remedies then suggested, and enables a better opinion to be formed as to whether or not there had been neglect on the part of the officers of the colliery. The book will, doubtless, prove of immense utility to all connected with the working of collieries in South Wales, as the various defects are brought forward in the evidence reported in it, and the opinions of a large number of eminent authorities as to the remedies which might prove successful carefully recorded; these particulars could not fail to enable the managers of other collieries in the district to prevent, at least from similar causes, accidents in the pits under their supervision.

* The Risca Colliery Explosion: A Full Report of the Evidence given at the Inquest. By HENRY EVANS. Newport: *Star of Gwent* office.

ON BLOWERS, OR OUTBURSTS OF FIRE-DAMP, IN COAL PITS.—At the Manchester Geological Society, Mr. E. W. BINNEY said he had seen a notice in the *London Review* about an extraordinary amount of gas that had burst out in one of the mines of the Kirkless Hall Colliery, and how successfully it had been removed. He asked Mr. P. Higson if he could give some particulars respecting it.—Mr. P. HIGSON: It happened some time ago, and the particulars are given fully in my annual report. The outburst of gas to which the Chairman refers was so great as to overcome the ventilation. It escaped from the floor between the side of a pillar and the goaf, about 2 ft. from the working face of the coal, in the Arley Mine, at the Kirkless Hall Colliery, in August, 1859. I had been previously through the workings, and found the ventilation all that could be desired. After the outburst Mr. Lancaster sent for me again, and when I reached the spot I found a rip in the floor of some 30 or 40 yards in length, into which I could put my arm up to the shoulder. The description of the outburst given by the overlooker was that the gas was given off with very great rapidly when all the colliers were at work. One of the men who was working there at the time told me that he perceived his lamp was full of fire-damp, and that he immediately drew down the wick with the picker, and called to the other workmen to do the same. An alarm was thus spread through the workings, which are very extensive, more than 350 people being, I dare say, engaged there. In the short space of three or four hours the gas had filled the intake air course for 1000 yards, the ventilation for a time being completely overpowered. In that condition it remained for 12 or 18 hours, when the ventilation, without any alteration or improvement being made, rectified itself, and swept harmlessly away the whole of the gas which had accumulated. I attribute the safety of the men in this instance to the lamps throughout the entire colliery being in a state of perfect repair, and to the maintenance of strict discipline. In some parts of the mine there was as much wind as as a man could bear whilst he was working, and more air for ventilation would have been objectionable to some of the men, still the outburst of gas overpowered and vitiated it, but fortunately the lamps were all perfect, and they were put fairly to the test. I have no doubt this has been the means of causing safety-lamps to be used more generally throughout the Wigan district than they were before.—Mr. ATKINSON: Is the mine where this outburst took place remarkable for fire-damp?—Mr. P. HIGSON: Yes, the Arley Mine, under whatever name it is known, throughout its whole extent, gives off fire-damp.—Mr. FARRIMOND: Somewhat previous to the occurrence now under notice a collier in the Peacock Mine heard the roof break, and the gas issue out like high-pressure steam. It went past all the men, and burnt in their lamps about 10 minutes, but as the men went towards the mouth of the pit to make their way out, it disappeared. Of course, had there been a defective lamp an explosion would have taken place, the cause of which might never had been known.—Mr. DICKINSON: An outburst is quite possible in this mine, but there is no doubt the explosion which occurred there before either Mr. William Blackburne or Mr. Farrimond had charge of the ventilation was from inadequate ventilation.—Mr. FARRIMOND: These outbursts of gas show the necessity of using safety-lamps.—Mr. LIVESEY: Do you recollect, Mr. Higson, the instance in the mine at Edge Green where the fire-damp burst through the roof?—Mr. P. HIGSON: Yes, I never before or since saw so much fire-damp as the outburst at Edge Green. The moment I got to the bottom of the pit I heard the blower giving off gas, which roared like steam escaping under great pressure, although it was several hundred yards from where I then stood. It could be heard distinctly for a very long distance underground, like a waterfall on a summer evening.—In reply to a question whether, as in the case at Kirkless Hall previously mentioned, the ordinary ventilation was sufficient to clear the pit of this gas, Mr. HIGSON said the quantity of gas which was emitted for a long time was so great that preparations of an unusual character become absolutely necessary, and until they were completed, operations in that district were partially suspended. Subsequently, the return gas from the locality of the blowers was passed along a return air-course made specially for that purpose, and through a dumb drift to the upcast pit.—Mr. DICKINSON: Was it quite clear that none of the gas came out of the old waste?—Mr. P. HIGSON: I could never find gas in the waste. I should think the return air-course was more than 7 ft. wide and 6 ft. high for a mile in length.—Mr. BINNEY: I think that in a coal mine there are ample reasons for persons to be always on their guard. It is a terrible thing to have to fight an invisible and intangible enemy, like fire-damp, which comes without giving any warning.—Mr. DICKINSON: But we know how to deal with it, and we know its indications. The misfortune is that people won't recognise its existence till it is upon them. They do not in some cases send a fireman round, nor use safety-lamps, unless fire-damp has been found "to prevail," as it is called. It is not that we do not know how to deal with it, but that the means which we have at hand are not taken to conquer it.—Mr. P. HIGSON: In the case of the Kirkless Hall outburst, I believe no ordinary amount of ventilation would have carried away or diluted that gas, if other precautions had not been taken, and if safety-lamps had not been used, and strict discipline maintained, an explosion would most certainly have taken place.—Mr. DICKINSON: The means of preventing explosions are well known; the precautions required being good ventilation, careful firemen, and safety-lamps, which may be easily adopted and carried out by any ordinary colliery manager.—Mr. BINNEY: It is the ignorance which prevails as to the nature of the enemy. The cost of lamps, managers, and ventilation, is nothing compared to the loss of property and life by an explosion. I don't think if masters knew the nature of the enemy they would grumble at the expense. Ignorance of the nature and occurrence of fire-damp is the great evil we have to contend with.—Mr. P. HIGSON: How can they plead ignorance when they know it may be suddenly liberated in the same way as it was at Kirkless Hall?—Mr. DICKINSON: Some of the cases of an outburst of fire-damp which I have met with have been from the Wigan 5-ft., the Pemberton 5-ft., the Pendleton, Crumbouke, and other seams, as well as the Arley Mine.—Mr. P. HIGSON: It was in the Wigan 4-ft. seam I found the blowers previously mentioned—they were issuing from the roof at the Edge Green Colliery.—Mr. BINNEY: The more people know of it, the more careful they will be with it. But about a practical man having what is called a practical knowledge of fire-damp doing strange things, I remembered the late Mr. Moses Mills informing me that near Oldham it was a common practice to try for fire-damp with a lighted candle, cutting off the long flame as it rose with the hand. These so-called practical men did some terrible things. Mr. Mills said he had worked for 30 years in coal pits, and had done the same thing, without being burnt.—Mr. P. HIGSON: I remember an instance in my district of an underlooker going with a naked candle, followed by a fireman with a safety-lamp, to examine the workings. The underlooker with his candle fired the gas, and was killed, and the explosion caused the death of the fireman also.

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AYTOUN'S PATENT SAFETY CAGE FOR MINES.

SAFETY FOR THE MINER.—An accident occurred at one of the pits belonging to Earl Granville, at Star Green, Hanley Potteries, by which ten men were killed and other ten severely injured. At Half-past Two a "cage," containing fourteen men, was being drawn up the shaft of the "big pit," while another cage with six or seven men in it was going down at the same time. As the ascending cage drew near the surface the signal-bell in the engine-room sounded as usual, in order that the engine might be at once stopped. The engine-tender was, however, too late in attending to his signal, and the consequence was that one cage was drawn up beyond its proper point, while the other went to the bottom of the shaft with a heavy shock. The ascending cage was drawn up till it reached the wheel over which the rope attached to it worked, and was being taken round, when the whole fourteen men, with one exception, were precipitated beneath; six fell down the haft, and were dashed to pieces; three fell on the pavement at the pit's mouth, and one on the iron pavement, and was killed on the spot; four who were thrown on the ground received fearful injuries. The occupants of the descending cage were all more or less injured by their fall, but none of them were killed. We have over and over again drawn the attention of mine proprietors and viewers to the imperative necessity of adopting means, now proved to be wholly effectual, for the prevention of lamentable accidents like this. Will colliery owners never listen to the pleading voice on behalf of the poor miners, which tells them that over-winding need never occur? In the present case of Earl Granville's pit, had such a disengaging catch and safety cage as is shown in our plate 232, for December, 1858, been fitted up, the most careless engine man could not have brought about any casualty whatever. The apparatus to which we have referred is that invented by Mr. R. Aytoun, of 3, Fettes-row, Edinburgh, and we quote it as being the most recent successful attempt at a safety cage.—*Practical Mechanics' Journal*, January, 1860.

FRIGHTFUL COLLIERY ACCIDENT.—An appalling occurrence happened near Wolverhampton on Saturday morning, which resulted in the instant death of seven persons. At a little before Six o'clock the colliers at the Blue Fly Pit, at the Wednesfield Heath Colliery of Mr. H. B. Whitehouse, assembled around the pit's mouth to descend to their work, down a shaft nearly 100 yards in depth. During the previous night the engine had been used in drawing water from the pit, and on Saturday morning the night engine-tender had left duty, and the engine-tender for the day had taken the engine in charge. On passing each other, the engine-tender who was going off duty said to his successor, "It's all right." Presuming upon the supposed truthfulness of the statement, the day engine-tender went confidently into the engine-house, and the colliers received the customary signal to jump into the skip; four men and three boys obeyed the signal, the engine was set in motion, and the skip raised a few inches from the wagon or platform that on such occasions forms the temporary covering to the mouth of the shaft, and the wagon was drawn away to allow the skip to descend. The engine had been scarcely reversed before it was found that the drum upon which the wire-rope that held the skip was coiled had been imperfectly connected with the engine. In no way held in check, therefore, it began to revolve with great rapidity, and in an instant the men and boys in the skip were literally dashed to atoms at the bottom of the shaft.—*Scotsman*, January 24, 1860.

These two accidents are given for the consideration of those who believe that safety cages are unnecessary where attention is paid to the state of the rope. In neither of these cases were the casualties owing to any deficiency in the rope or gearing, and yet seventeen lives have been sacrificed, not one of which would have been lost had a safety cage with its disengaging catch been in use.

DESCRIPTION OF CAGE.

The only novelty in this cage lies in the upper slides, or shoes, and their appendages. These slides, or shoes, B C, are two in number; but being placed on opposite sides of the cage, only one of them can be seen in the drawing. Each of these slides has a single bolt, or stud, B, by which it is attached to the cage, and around which it turns; a long arm, A B, to the extremity of which the winding chain is attached; a stop, H, which prevents the arm from being pulled above the horizontal line; and a spring, E F, which lowers it when the winding chain is slack.

From this description it is easily seen that, in the event of the rope or gearing giving way, as in Fig. 2, the springs, E F, so tilt the shoes, or slides, B C, that they immediately seize hold of the guide rods in the same manner as a boring key in the hands of a miner lays hold of the boring rods, and with the same tenacity of grip; and although the rope should come down on the top of the cage, the only effect would be to cause the shoes to dig deeper into the guide rods, and thus to make the hold more secure. The means of arresting the cage in its descent being thus provided, there need be no hesitation in adopting the "disengaging catch," whereby, in a case of over-winding, the rope is let go and the cage remains safely suspended from the guide rods.

It may be mentioned that the safety apparatus costs little money, can be fitted to existing cages, and is alike applicable to guide rods of iron or wood. Moreover, when brought into action it does not injure the guide rods, and, consequently, after an accident, in which lives and property may have been saved, the winding may be proceeded with almost immediately.

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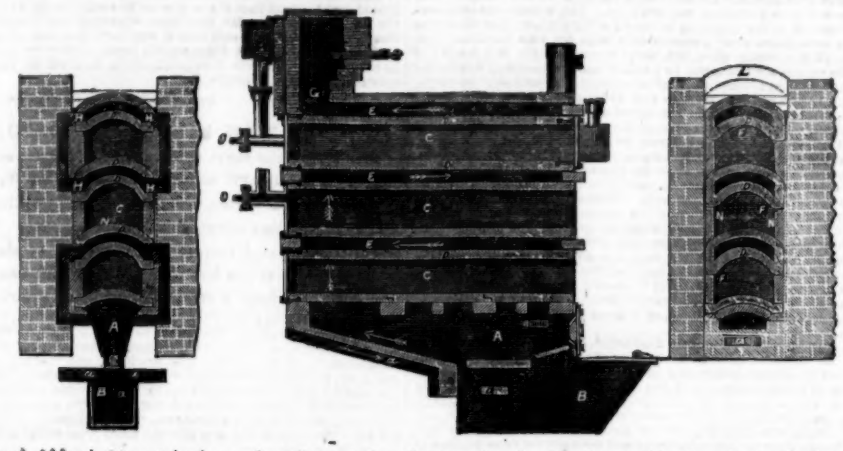

The *Mining Journal* of March 30 contained a condensed description of of the new inventions exhibited now at the Society of Arts.

During the *conversazione* on the 4th inst., at the Society's rooms, our attention was attracted to a model, showing some novel improvements in gas making, effecting apparently considerable saving in furnace fuel, invented by Mr. George Walcott, 24, Abchurch-lane, London. The simple arrangement for supplying the furnace with heated air, thereby intensifying combustion, besides preventing smoke from forming, seems capable of being beneficially used in other furnaces. Old gas companies may spare themselves a part of the expense when engaged in enlarging their works, to meet an increased consumption, by merely removing the old back wall and cumbersome covering brick arch of their present retort settings, erecting in the increased space obtained an additional number of larger sized retorts. Similarly, new gas companies may save themselves any extra outlay for a comparatively unnecessarily large gas-house—more than sufficient for their first operations, and solely for anticipating future wants, which may or may not occur, as by this invention only two side walls are necessary for enclosing the retorts; consequently, a further make of gas is obtained by placing above the first retorts a second set, and repeated by a third set, as necessity should happen to require. The space occupied by these patented retort settings is considerably less than by the old method. The ash-pit is absolutely closed in front of the furnace with an iron lid, removable for clearing out ashes, so no cold air can penetrate through the strong fire-clay furnace bars; but, instead, heated air obtained by passing it through a flue built in the solid brickwork immediately underneath the floor of the ground fire-flues. This facilitates the introduction of clay retorts into small gas-works, as but little damage could result from any temporary neglect of the furnace fire. Our hearty welcome is given to any feasible mode of effecting the dispensing with painful human labour; such applies to the idea of fixing a draft-pipe to the end of a gas retort arranged for connection, at will, with the chimney shaft; so when the mouth-piece lid is removed the retort forms a flue, and burns out the incrustation of carbon, saving the present necessity of cutting it out with a long iron tool when the retort is at a high heat. The number of working retorts in a setting containing (say) twelve, nine, or six retorts, can be reduced as wished; for instance, supposing the requirements of any gas-works be six retorts in winter, and half that number in summer, then, instead of cooling one set and the firing up another distinct setting, half, or any other number of retorts, can be thrown out, without disturbing the working of the others or letting out the furnace fire.

Two cross sections through the furnace, and another cutting the centre, being of a bed for three retorts, each 22 in. wide, 13 in. deep, and 9 ft. 6 in. long, are shown, in order that the description attempted may be clearly understood; according to which A is the furnace; B a closed ash-pit; A A flue conveying hot air from the further end into the ash-pit, for supplying C C C, rounded floor retorts, but may be constructed of any shape, oval or circular; D longitudinal flues, having throughout their whole length an opening for the passage of fire, 22 in. wide by 4 in. deep. The course of the flue is shown by the arrows, being in two streams to the back, returning to the front in one concentrated body, where it rises and returns to the back, consequently no fire is lost by the reverse sides of flues, nor on unproductive arches and side walls, enclosing retorts; but instead, the fire is passing through and through the materials to be heated, causing great economy of furnace fuel. H H, by stopping these inlet holes with a loose brick, the ingress of fire is prevented, and can be turned aside; this permits the heating alternately of all or fewer retorts. F F, draft-pipes, which can be kept by screwing a piece of wrought-iron pipe into them, as shown at O O. The main flue at back is carried by arch L, 22 inches wide, and 4½ in. deep permanently. N N, though the fire only plays directly under and below the retorts, there is a uniform heat over the whole inner surface of the retort. A stack containing six of these patent retorts are in course of erection at the Petworth Gas-works, Sussex; a second six bed at St. Ives, Hunts; a large bed at the West London Gas-works, Wormwood Scrubs; another at Oakham; also at Hornsey, London; and Philadelphia, Pennsylvania, United States.

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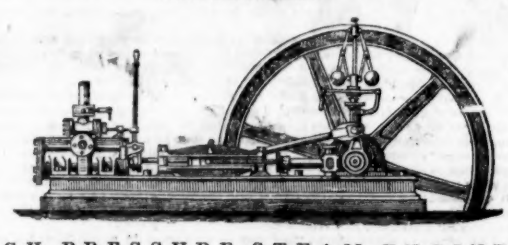

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